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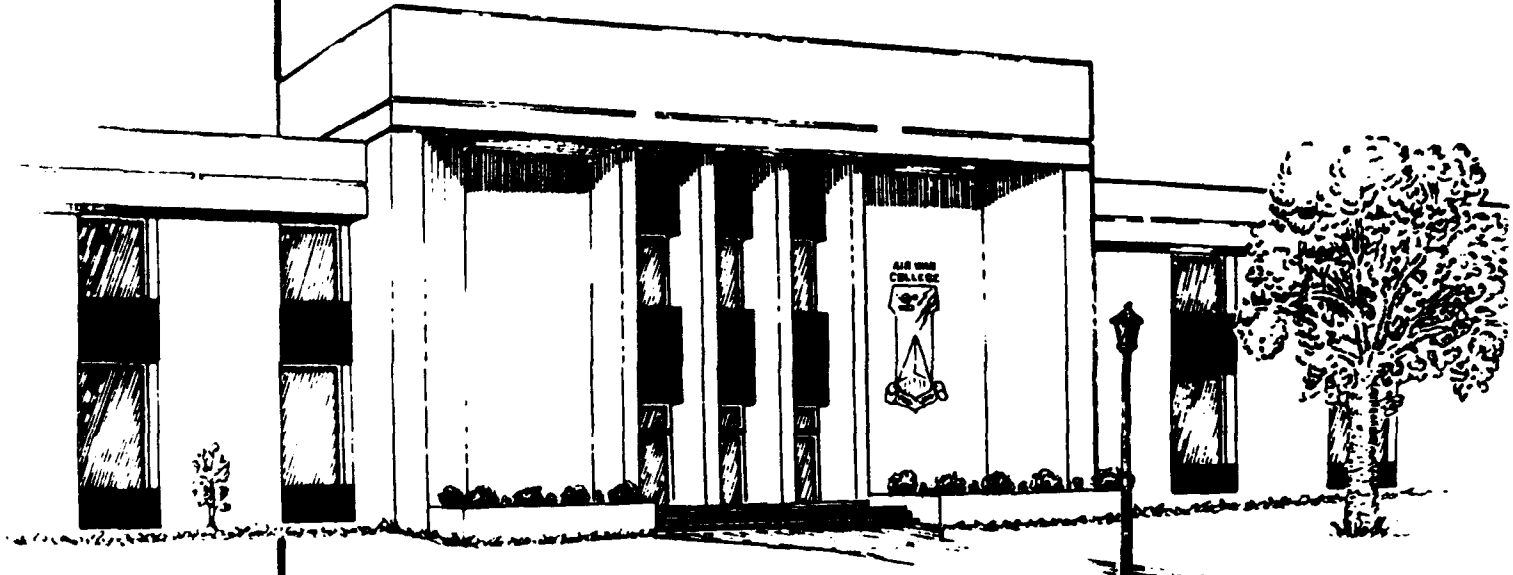
RESEARCH REPORT

IMPROVING TECHNOLOGY INSERTION IN EXISTING AIR FORCE WEAPON SYSTEMS THROUGH THE AFLC MODIFICATION PROCESS

MR ROGER M. ASHLEY

1990



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IMPROVING TECHNOLOGY INSERTION IN EXISTING AIR FORCE WEAPON SYSTEMS THROUGH THE AFLC MODIFICATION PROCESS

by

MR. ROGER M. ASHLEY
DEPARTMENT OF THE AIR FORCE

A DEFENSE ANALYTICAL STUDY SUBMITTED TO THE FACULTY

IN

FULFILLMENT OF THE CURRICULUM

REQUIREMENT

Advisor: Lieutenant Colonel James M. Jackson III

MAXWELL AIR FORCE BASE, ALABAMA

May 1990

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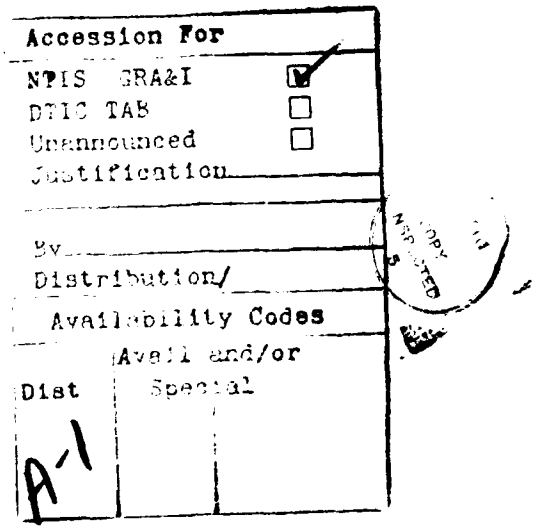

EXECUTIVE SUMMARY

TITLE: Improving Technology Insertion in Existing Air Force Weapon Systems Through The AFLC Modification Process

AUTHOR: Mr. Roger M. Ashley, Department of the Air Force

Current trends indicate that the majority of the aircraft that will be operating in the USAF in the year 2000 are already sitting on Air Force flight lines. These aircraft will be the backbone of our force structure well into the 21st century. However, these aircraft are aging. A key to the USAF retaining affordable combat capability is inserting evolving technologies into older weapon systems through the modification process. However, that has proven to be a difficult task. A review of Air Force policy on modification management reveals that technology insertion is not directed. Air Force Logistics Command (AFLC) has established several programs to facilitate technology insertion, but has not evaluated modification management to determine if technology insertion is being accomplished efficiently and effectively. In addition, there are numerous impediments and barriers to technology insertion. Improving technology insertion in existing weapon systems can only be done if AFLC System Program Managers make it a personal priority to ensure that technology insertion is accomplished on the weapon systems they manage.

BIOGRAPHICAL SKETCH

Roger M. Ashley (M.S., Air Force Institute of Technology) has been interested in technology insertion since he was assigned as the Director, Studies and Analysis, Deputy of Integrated Logistics, Air Force Acquisition Logistics Center, Wright-Patterson AFB, Ohio, in 1988. He previously served in acquisition logistics in several Aerospace Systems Division (ASD) System Program Offices. He is a graduate of Armed Forces Staff College and accomplished Air Command and Staff through seminar. Mr. Ashley is a graduate of the Air War College, class of 1990.

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CHAPTER I

PROBLEM DEFINITION

Introduction

According to experts, moving technology from Department of Defense laboratories or industry into the field takes too long, often from 9 to 15 years. (1:1; 2:205) While the Air Force waits for tecnnology, combat capability is degraded, life cycle costs are often higher and operations and maintenance budgets increase. As the DOD budget continues to get cut, the Air Force needs to look for technological opportunities to improve existing weapon systems capabilities, reduce life cycle costs and eliminate operations and maintenance costs through technology insertion. The purpose of this paper is to determine if Air Force Logistics Command (AFLC) is efficiently and effectively inserting technology into existing weapon systems through the modification process.

The Air Force uses a three-fold approach to maintain combat capability in this constrained resource environment: (1) ensure the readiness of forces already fielded by focusing on spares, support equipment, munitions, and training programs; (2) improve existing systems with cost-effective modifications (emphasis mine); and (3) develop new systems. (3:vi)

Historically, modifications have been important because many USAF aircraft were aging and their operational performance had to be improved. The same is true for today's fleet. Twenty-eight years is the average age for B-52s, about 18 years is the average for F/FB-111s, 15 years for C-5As, and about 20 years for all C-130s. Even among USAF's newer aircraft, there are pockets of age. A-10s, E-3 Airborne Warning and Control System aircraft, and F-15 fighters are at least nine years old. (4:44) Yet these

aging aircraft, maintained and supported by AFLC, will be the mainstay of our combat capability for the next decade.

The costs of new, sophisticated weapon systems are dramatically increasing. New weapon systems are becoming too expensive in Congress's and the public's view. And at the same time, procurement budgets are decreasing. (5:110) Therefore, enhancement modifications using evolving technologies are going to become even more important. (6:212; 7:207; 8:223)

Before discussing the topic any further, one must understand what is meant by "technology insertion." Transistion, transfer, transfusion and insertion are sometimes used interchangeably. The difference is briefly explained here. "Transistion" is often referred to as the vertical movement of technology from a laboratory to a system. This type of work is normally done by Air Force Systems Command (AFSC) using research and development (R&D) funds. "Transferring" and "transfusing" both refer to the horizontal movement of technology from one system to another. For example, an Aerospace Systems Division (ASD) system program office developed an on-board oxygen generating system. Then they worked with several ASD aircraft system program offices to get the established and developed technology into evolving Air Force aircraft. "Transfer" sometimes refers to the positive idea of moving technology from the federal sector to the private sector or vice versa, but it is also used with a negative connotation referring to moving U. S. technology to an enemy. This report will use "insertion" to describe the movement of technology into weapon systems managed by AFLC. (1:2) The distinction is made because AFLC system program managers do not manage programs that use research and development funds. If AFLC is inserting technology into a weapon system,

the technology has to exist. If the technology has to be developed, AFSC is given program management responsibility.

Problem Statement

Given the Air Force's increasing dependence on modifications, it is time to assess how AFLC is doing in technology insertion. Does Air Force policy modification management direct technology insertion? Is technology insertion included in the AFLC modification process? Has AFLC been doing modifications efficiently and effectively? This report will address these questions and then conclude with how AFLC could improve technology insertion into existing weapon systems using the modification process.

Scope of the Report

This report will identify several problems with getting technology inserted into modifications managed by AFLC. Some problems are caused by the lack of integrated Air Force and AFLC policy on technology insertion in modifications. This issue is described in Chapter II. Two more problems are that the AFLC modification process has not been efficient, according to the Air Force Audit Agency, and that technology insertion in the modification process has not been audited or inspected. (Chapter III). In addition, there are numerous impediments and barriers to technology insertion that AFLC must overcome (Chapter IV). Therefore, it is possible that AFLC may not have selected the best modifications for aging weapon systems because technology insertion was not thoroughly considered in the modification process (Chapter v).

This report will NOT address modifications managed by Air Force Systems Command because evaluating and designing in technology is a fundamental part of the systems development process.

CHAPTER II

MODIFICATION GUIDANCE -- DOES AIR FORCE POLICY DIRECT TECHNOLOGY INSERTION?

Introduction

The problem with technology insertion at the national level is described in this quote from the Secretary of Defense's Fiscal Year 1990 Annual Report to Congress:

> Another critical challenge confronting the United States and its allies is how to effectively transfer the technology we develop to deployed systems. Very little, if any, military benefit can be derived from technology achievements that remain in the laboratory. Therefore, reducing the lead time for incorporating new technology into our military weapon systems is one of our principal goals to improve the acquisition process. Numerous factors, however, make this difficult. For example, there is often no correlation between the pace of technology development and windows of opportunity for insertion. In addition, demonstrated technology is not always readily producible, and current or projected warfighting doctrine does not always include integration of new concepts into the force structure. Technology transfer, therefore, is a management concern requiring close interaction between the requirements and development communities and the users in order to be successful (emphasis mine). (2:205-206)

The Secretary of Defense recognizes that there are numerous factors that prevent the incorporation of new technology into our military weapon systems. But does Air Force policy deal with the issue by directing that technology insertion be considered in the modification process? In this chapter I will answer this question by examining the applicable regulations in numerical order. The purpose of each regulation will be summarized, whether or not it directs technology insertion will be discussed, and, lastly, suggestions will be made on where technology insertion direction could be added.

Air Force policy and direction about the modification process is primarily contained in the 57-series and 800-series regulations. There is supporting guidance in the 27-series and in the 66-series.

The 27-Series Regulation

Air Force Regulation 27-8, titled Systems and Equipment Modification and Maintenance Program, provides policy and assigns responsibilities for programming of modifications in the annual Program Objective Memorandum (POM) process. Both AFLC and AFSC are responsible for submitting their requirements for modification funding but there is no mention of technology insertion. (9)

The 57-Series Regulations

There are two Air Force 57-series regulations that address management responsibilities for modifications. The first is AFR 57-1, titled Operational Needs, Requirements, and Concepts. It "outlines Air Force policies, procedures, and responsibilities for identifying, processing, and approving operational requirements which result in research, development, test and evaluation (RDT&E), or procurement appropriations." (10:1)

The operational requirements process described in AFR 57-1 begins with identifying operational needs in a "statement of need" (SON) and continues throughout the acquisition process and the life of the system. A SON is written for needs that cannot be met through changes in tactics, strategy, doctrine, or training, and where solutions require a new development, new procurement, or upgrade of an existing system. SONs are mandatory for most major weapon system upgrades (some low cost Class V modifications are exempt as explained in AFR 57-4).

Operating commands are told to consider deficiencies, technological opportunities, and expanded missions when identifying operational needs.

> Deficiencies typically result from threat changes, redefinition of assigned tasks in response to shifts in national security policy, or deterioration in operational performance of older systems (emphasis mine). Technological opportunities arise when technological advances make possible increased operational effectiveness or lower costs. (10:5)

Operating commands are the prime agents for identifying operational needs in SONs. In the paragraph on "SON Considerations," the operating command is directed to consider "technological advances and limitations, affordability constraints, supportability requirements, integration, preplanned product improvement possibilities," etc. (10:4) The operating commands should be told how or where to find technological opportunities and how to incorporate them into the proposed solutions for the needs. One method for accomplishing that objective would be to ensure that appropriate AFSC laboratories, AFLC system program managers, AFLC Technology Application Program Managers and specialty offices, like the Air Force Office for Logistics Technology Applications, get to review the SON in draft.

The operational requirements process is an iterative one that encourages weeding out least cost-effective alternatives.

> A major element of the operational requirements process is the continuing identification of meaningful performance tradeoffs whereby high cost features providing only marginal performance gains are deleted from the system. (10:3)

The direction should insist that technology insertion be considered in the tradeoff process.

In what appears to be an afterthought, AFR 57-1 defines a logistics need. A logistics need is "an Air Force logistics requirement submitted to

the Air Force Coordinating Office for Logistics Research (AFCOLR) by an operational command to develop long-term technology solutions to their logistics problems." (10:21) In fact logistics needs often identify the very technological concerns that should be considered and resolved in the weapon system modification process, not parcelled off into a separate process. The Air Force has recognized this disparity and will publish a new regulation, AFR 80-33 titled Air Force Combat Support Research and Development Requirements (Logistics Needs) Program, in the next 60 days.

The second 57-series regulation is AFR 57-4, titled Modification Program Approval and Management. Modification programs offer the Air Force ways to correct deficiencies in or improve the capabilities of existing Air Force equipment in lieu of new development programs. This regulation is the heart of modification policy. It contains the "procedures for planning, documenting, obtaining approval, and managing the modification." (11:3) It provides detailed steps for each phase of the modification process. Unfortunately, technology insertion is not included as a consideration or step in any of the detailed discussion.

Technology insertion policies should be added to paragraph 2 "Modification Policies". Definitions of technology insertion and transistion should be added to attachment 1 "Terms Explained". And I think technology insertion should also be added to attachment 8 "Class IV Mod Key Steps", attachment 9 "Class IV Aircraft Modification Flow Chart", attachment 10 "Class V Mod Key Steps", and attachment 11 "Class V Aircraft Modification Flow Chart".

Other Air Force 57-series regulations exist, but a cursory review showed that modification management is not addressed, nor is technology insertion mentioned.

Air Force Logistics Command Regulation 57-21

AFLC Regulation 57-21, titled Modification Program Requirements Development, Approval, and Management, establishes AFLC policies, responsibilities, and procedures for the documentation, processing, and approval of modification programs. (12) The previous version of this AFLC regulation, dated April 1979, did not include AFLC policy or direction on technology insertion.

HQ AFLC recently recognized the need to rectify this lack of direction and published interim guidance in a HQ AFLC/MM letter dated 27 November 1989, subject: "Consideration of Advanced Technology in Modification Planning", to each Air Logistics Center Director of Materiel Management (ALC/MM). The cover letter states:

> It is essential in view of the future austerity of DOD funds that we push full consideration of advanced technologies in the planning of all modification proposals. The end objective is to offset the anticipated reduction in logistics appropriations through gains in reliability and maintainability.
>
> A change to AFLCR 57-21 is currently in the publication process which, in addition to other revisions, will prescribe the new procedural steps considered necessary to achieve this objective. The most relevant procedural change along these lines is included as attachment 1. **We believe the merit in this change is significant and it warrants immediate implementation** (emphasis mine). (13)

The interim change has been included in the revised and recently published AFLCR 57-21, dated 25 November 1989. The change, which is in Chapter 4 of the newly published AFLC regulation, requires a task "to consider the availability and/or applicability of advanced technology" be included in any statements of work to obtain Engineering Change Proposals

(ECPs). The ALC engineering community (ALC/MME) is given the responsibility to assure full consideration of advanced technologies. (12:7-8)

The new regulation also adds a requirement for a Weapon System Modification Master Plan (WSMMP). The AFLC System Program Manager is responsible for developing and maintaining a WSMMP for all his programs.

> This plan addresses requirements for the correction of operational deficiencies or improvements in material support, R&M, or technology. ... This plan must be comprehensive and time-phased, address the major subsystems of the weapon system, and coordinated with the using command. It will serve as a road map and tool for integrating and scheduling future modifications. (12:9)

In my opinion, the AFLC regulation would have been stronger if the requirement to consider technology insertion were included in attachment 2, "Modification Checklist" (for use in approval documentation preparation), and in attachment 6, "CCB Member's Modification Validation Checklist." AFLC has taken one step toward providing policy on technology insertion. Of course, a lot remains to be done to institutionize the change.

The 66-Series Regulations

There are two 66-series regulations that address management responsibilities for modifications. The first one is AFR 66-2, Single Manager for Modification, Major Maintenance, and Test Programs on Air Force ICBM Systems. It provides responsibilities for commands involved in technical alteration to features of the ICBM force. This regulation does not discuss technology insertion.

AFR 66-30, Product Improvement Program (PIP) for Operational Equipment, provides policy and responsibilities for "improving operational

Air Force systems, subsystems, and equipment." (14:1) PIP objectives are to:

> ... improve the cost-effectiveness, readiness, and safety of products in the Air Force operational inventory; prevent the recurrence of deficiencies in design; apply state-of-the-art technology to existing systems to correct deficiencies or extend operational life (emphasis mine); and maintain the combat effectiveness of operational weapon systems. (14:1)

The System Program Manager (SPM) chairs a Product Improvement Working Group (PIWG) composed of representatives from AFSC, AFLC, and one (or more) operating command(s) to evaluate a specific system (like a B-52 or F-16) and accomplish the PIP objectives.

Problems submitted to the PIWG for action are prioritized as critical [those causing excessive Not Mission Capable (MICAP) conditions], warstoppers [identified in the Weapon Systems Management Information System (WSMIS)], urgent (impending MICAPS, aborts, etc.), or routine to enable the SPM to direct limited assets (funds or manpower) to the highest priority problems. (14:2-3) I think this kind of priority system is essential to identifying the most effective modification for the funds that are available. And it also focuses management attention on specific problems so that solutions can be pursued in specific technologies, thus improving the possibility for insertion.

This regulation describes the idea of technology insertion in the product improvement evaluation process, but it does not specifically mention technology insertion. Technology insertion should be included as one of the PIP objectives. And a requirement should be included in the procedures for the PIWG for the System Program Manager to consider

logistics needs that have been identified for and could apply to his particular weapon system.

The 800-Series Guidance

The 800-series regulations provide guidance primarily for acquisitions involving research and development of a complete new weapon system or upgrades to existing weapon systems that involve research and development (e.g. the FB-111 Avionics Modification Program). Over the past 10 years, the number of 800 regulations have increased to include Air Force direction from many different functional perspectives (such as avionics control, integrated logistics support and support equipment to name just a few). As a result of the Defense Management Review, the 800 series regulations are being condensed down into two or three regulations written essentially for program managers. I was not able to get draft copies, but I have been told that most functional perspective guidance has not been included.

Chapter Conclusion

The review of Air Force regulations shows that they provide detailed guidance on the initiation, approval and management of modifications, but they do not specifically direct that technology insertion be considered during the modification process. The recent AFLCR 57-21 includes technology insertion, but has not been "on the street" long enough for any impact to be measureable. My conclusion is that the lack of top-down, integrated policy to include technology insertion in the modification process is certainly a contributing factor, if not one of the major reasons, it does not appear to be a significant consideration in modification management.

CHAPTER III

IS TECHNOLOGY INSERTION BEING ACCOMPLISHED EFFICIENTLY AND EFFECTIVELY IN MODIFICATIONS MANAGED BY AFLC?

Introduction

The United States Air Force Report to the 101st Congress of the United States of America, Fiscal Year 1990, cites several successful modification programs as examples of the Air Force's second element in leveraging force investments by improving existing systems with cost-effective modifications and upgrades.

> The newest B-52, which has served us well for over 25 years, will continue to serve for at least another decade. The re-engining of the KC-135 gives that aircraft an extended service life and greatly enhanced capability. The entire C-141 fleet was improved by stretching the fuselage and adding an inflight refueling capability, resulting in an equivalent of about 90 more C-141's. And, thanks to well-executed upgrades, the 14-year-old F-15 remains the best air superiority fighter in the world. (3:vi)

The report does not include any examples of technology transfer or insertion. In fact, the report does not mention these topics at all! Recall that the Secretary of Defense's Fiscal Year 1990 Report to Congress (quoted in the introduction to Chapter II) considered technology transistion a "critical challenge". (2:205) The Air Force missed a golden opportunity to describe its achievements in technology transfer and insertion.

Unfortunately, there are also examples of technology transfers that could have been done but were not. It took the Air Force 14 years to introduce leak free hydraulic fittings into the inventory. Navy F-14's had them and flew over 350,000 fittings for 14 years without leaks. Thanks to

the Air Force Coordinating Office for Logistics Research, this technology is now being used in standard fittings for the C-5B and the B-1. (1:3)

Another example is found in carbon-carbon brakes. They were proven on the F-15 in 1971. They were not used on F-16's until a value engineering effort pushed the technology into the F-16 in 1980. (1:3)

Articles on Technology Insertion in AFLC

Technology transistion and insertion are being accomplished in AFLC. Two articles in the August 1989 issue of Air Force Magazine provide examples. The first, "More Mileage from Older Warplanes," describes the Aircraft Structural Integrity Program (ASIP) and how AFLC uses magnetic rubber, eddy currents, X-rays and other unusual techniques to keep USAF's aging fleet going. "ASIP workers are facing a fleet of 6000 planes whose average age, 15.8 years, is sure to rise." (4:42) One of the primary products of ASIP analysis is detailed advice on when, where and how to modify older air vehicles in order to maximize the number of flying hours the Air Force gets from its original investment. "Such ASIP information has been used to plan the orderly wing-reskinning and reengining of the KC-135 aerial refueler, rewinging and structural strengthening of the B-52, and wing modifications to the C-141 airlifter." (4:44) Thus, current technologies (in terms of aerospace design, metals, composites, structures, forgings and adhesives) were considered and designed into these major modifications.

The second article, "Squeezing More From the Logistics Dollar," describes several new programs AFLC is implementing to get the most from every available asset. One efficiency change is a deceptively simple one:

> AFLC is focusing its repair operations on problems that can actually ground an airplane, rather than trying to fix absolutely every problem, large or small. Setting priorities in this manner has already increased the mission capable rate of the F-16 by eight percent. (15:33)

AFLC is implementing the priority categories described earlier in AFR 66-30, Product Improvement Program for Operational Equipment. Although this is not an example of technology insertion, it is an example of improving the effectiveness of the modification process.

Another initiative mentioned in that article is that AFLC has recently established a chief scientist to provide the command liaison to the scientific community. "The idea is to ease the logistics burden by inserting new technology in old systems." (15:34) AFLC has taken another step in focusing senior management attention on technology insertion.

Programs for Technology Insertion in AFLC

Two other AFLC programs (out of several) that facilitate technology insertion into the AFLC modification process are the Weapon System Master Plan and the Technology Application Program Manager Program.

The Weapon System Master Plan (WSMP) is a 10 year projection of operational and logistics requirements for a weapon system. It provides the "big picture" view that a System Program Manager uses to manage his weapon system. One of the sections titled, "Technology Insertion Opportunities", describes needed capabilities and/or unresolved deficiencies for which there is no fix programs due to lack of available technology. Since the WSMP is used as a programming document by the SPM, a technology "need" included in the document will be considered as a requirement. Unfortunately, this documentation does not assure the

technology is inserted, but it does make it a part of the desired weapon system baseline and therefore, enhances its chances. (1:13; 16)

The Technology Application Program Manager (TAPM) program's objective is to accelerate the transfusion of technology into the Air Logistics Centers (ALCs) and eventually into weapon systems. Individual program managers are selected to represent specific technologies at a "sponsoring" ALC. Two new TAPM assignments were made recently. Cryogenics was assigned to San Antonio ALC and photonics was assigned Ogden ALC. That brings the total number of technologies assigned to 19. The TAPM's job includes advocating their technology throughout AFLC and identifying specific candidates where their technology can be applied. They work hand in hand with the SPMs to facilitate two to four prototypes or actual insertions for each technology candidate. (1:19; 17)

Given these examples of and programs for technology insertion in AFLC modifications, it is evident it is being done. Now the question is: "How efficiently and effectively is it being done?"

Air Force Audit Agency Report on AFLC Modification Management

The Air Force Audit Agency has audited the AFLC modification process for years. I asked an auditor at Wright-Patterson AFB if they had ever evaluated technology insertion in the AFLC modification process. He replied they had not. (18) I asked him what they looked for when they evaluated AFLC modification management. He sent me their most recent report.

The report, titled "Review and Approval of Air Force Class IV and V Modifications", had the following audit objectives: "to evaluate (1) the timeliness of class IV and V modification review and approval procedures;

and (2) the effectiveness of management actions taken during the modification review and approval process". (19:2) I have included some information from that report to show where the auditors and AFLC management have been focusing their attention.

The report was accomplished at HQ AFLC and at Sacramento, Oklahoma City and Warner Robins Air Logistics Centers. The auditors selected 28 class IV and V modifications that were included in the Fiscal Year 1988 Budget Estimate Submission for F-111, B-52 and C-130 aircraft. This sample included 14 class IV modifications valued at $2.1 billion (out of a universe of 44 class IV modifications valued at $2.8 billion) and 14 class V modifications valued at $2.5 billion (out of a universe of 33 class V modifications valued at $4.5 billion).

The report stated "overall management and control needed improvement. There were significant delays throughout the entire process." And that "improved procedures were needed to increase the effectiveness of management actions taken during the review and approval phase of modifications." (19:3) AFLC managers were aware of these problems.

AFLC Management Comments

> Our efforts to improve the modification review and approval process have been guided primarily by results of the 1984 AFLC Modification Management Study. The study made 62 recommendations for correcting the same kind of problems this audit identified. ... For several years now, we have recognized the need to improve the modification process. (19:3-4)

Then I asked an AFLC Inspector to review past inspections to see if the AFLC IG had ever evaluated technology insertion in the AFLC modification process. He found no evidence that an inspection had ever been accomplished on that topic. (20)

I have included this information to show that althought the AFLC IG, AFLC management and the Air Force Audit Agency have been evaluating the AFLC modification process for years -- technology insertion has not been a topic of evaluation. My conclusion, therefore, is that the efficiency and/or effectiveness of technology insertion in AFLC modifications has never been evaluated. Of course, the HQ AFLC/MM interim guidance and the revised AFLC regulation were just published in November 1989. Perhaps the AFLC IG and the Air Force Audit Agency will be called upon to evaluate this topic in the future.

Chapter Conclusion

The **Air Force Magazine** articles provided examples of technology applications in AFLC. The Air Force Audit Agency reports that AFLC modification management is not timely and improvements are needed to increase the effectiveness of management actions during the review and approval phase of the process. AFLC management has been working on these issues since at least 1984. But neither the Air Force Audit Agency nor the AFLC Inspector General had ever evaluated technology insertion in the AFLC modification process. I found no evidence that technology insertion is being done efficiently or effectively either on individual weapon systems or at the Air Logistics Center level.

CHAPTER IV

IMPEDIMENTS TO TECHNOLOGY INSERTION

Introduction

The AFLC System Program Manager (SPM) manages the modification process for his weapon system. In chapter II, I described the November 1989 AFLC policy that directs SPMs to consider technology insertion in modifications to their weapon systems. In chapter III, I mentioned three AFLC programs (ASIP, WSMP and TAPM) which should assist SPMs with technology insertion. In this chapter I will briefly identify several impediments that interfer with technology insertion. Then I will discuss the two impediments which I believe prevent many AFLC SPMs from thoroughly considering technology insertion.

Two recent papers describe impediments to technology insertion: "Technology Transfusion - A Network Recommendation" by Major Greg Padula (1) and "Bashing the Technical Insertion Barriers" by Mr. Stephen Gullfoos (21). I will identify the impediments discussed in each paper and summarize the actions they suggest be taken to overcome these impediments.

Accelerating the Technology Transfusion Process

Major Padula was the chief of the Plans and Programs Division in the Air Force Coordinating Office for Logistics Research (AFCOLR) for three years. During that time he gathered the ideas and information that formed his excellent report. In it he explains how the technology transfusion process can be accelerated to increase combat capability for relatively low-risk high-payoff technologies. He identifies six major impediments to transfusion which affect the whole Air Force: undocumented requirements.

requirements, lack of information, lack of incentives and perceived high risk, lack of funding, resistance to change, and insufficient linkage/ advocacy. This quote describes them in a little more detail:

> Undocumented requirements especially in the program management directives (PMDs) (or program action directives (PADs) for AFLC programs) and the statements of work (SOWs) of the various contracts often force the decision maker to choose the least expensive technology that meets the documented requirements and therefore not chose a candidate technology lest he lose the contract. Lack of information concerning what technologies are available, what their benefits are, and what risks are involved was the most cited reason as a transfusion impediment. Lack of incentives and perceived high risks relates to a host of questions concerning both the risk one must take if he is to transfuse the technology (negative incentive) and the missing positive incentives that motivate one to change things. Lack of funds, from either internal or external sources, will stop a technology from being inserted. Resistance to change even though the technology has been demonstrated is cited as the most significant reason why technology does not transition according to a 1986 study. The final impediment listed, insufficient linkage/advocacy, if overcome, can help break each of the individual barriers through advocacy as well as create tremendous synergy by linking the various efforts. (1:viii)

Major Padula goes on to describe approximately 20 organizations and processes that work on pieces of the technology transfusion process (e.g. planning, documenting requirements, identifying technologies, reducing risk through prototype validation, funding, and linking/advocating technology). He recommends that one central organization be chartered and manned to advocate and link (integrate) transfusion efforts across the Air Force using a networking approach.

Air Force Office for Logistics Technology Applications

Major General Joseph Spiers, recent commander of the Acquisition Logistics Division (ALD) in AFLC, created the kind of organization Major Padula recommended late in 1989 by combining and integrating several separate offices. The new organization is called the Air Force Office for

Logistics Technology Applications (AFOLTA). It is a new deputy in the ALD located at Wright-Patterson AFB.

A recent revision to AFR 23-35, titled Air Force Logistics Management Center (AFLMC)/Air Force Office for Logistics Technology Applications, incorporates AFOLTA (formerly AFCOLR), places both AFLMC and AFOLTA under the Logistics Board of Directors review process (AFR 20-7), clarifies that AFLC and ALD provide administrative support for AFLMC and AFOLTA respectfully, and that both organizations have Air Force-wide missions. (21:24)

AFOLTA's strategy is to (1) understand technology related planning, execution, and advocacy processes; (2) find opportunities (process pressure points) where technology decisions are or can be made; (3) understand customers' (users, decision makers, inserters) needs; (4) develop/implement customer oriented tools, procedures, and training; (5) improve processes for funding technology applications; and (6) improve business practices to overcome impediments to technology applications. (22) AFOLTA has an important job. But overcoming impediments to technology insertion out in the Air Logistics Centers all the way from Wright-Patterson AFB will be very difficult.

Bashing the Technology Insertion Barriers

The second paper, "Bashing the Technology Insertion Barriers" by Mr. Stephen Guilfoos, a senior engineer in AFCOLR, discusses three types of barriers: technical, regulatory, and people. He provides numerous examples of each kind of barrier. Then he provides strategies for attacking the barriers which he summarizes into ten rules for success. He concludes with:

> The biggest secret to success is COMMUNICATION. This entails both talking and listening. Technology application depends upon many folks from different organizations. We should realize that there may be language, cultural, social, and educational differences between the researchers, developers, contracting officials, and field users. They each have their own objectives and goals. (23:32)

Both authors describe the two impediments that I believe prevent many AFLC SPMs from thoroughly considering technology insertion: risks and funds. Major Padula asks: "Why should a SPM use a new technology that may cause him to do a poorer job on the items he is rated on, such as cost and schedule?" (1:8)

I concluded from the two papers that an SPM would like to have five things to overcome impediments and give technology insertion a chance. He wants: (1) policy guidance (and even direction in his Program Action Directive), (2) a user requirement and a matching (preferably low risk) technological solution, (3) the opportunity to implement the solution in the modification process, (4) minimum schedule risk, and (5) adequate funds.

Unfortunately, when technology insertion has to compete for limited modification (internal) funds, both the user and the SPM have to be convinced that the technological and schedule risks are low enough that the modification program will not be jeopardized. Otherwise, the funds will be allocated to a surefire solution for some other performance or capability requirement. Even if the technology insertion initiative comes with its own funds (external), it must fit into the schedule or it will likely be avoided.

Chapter Conclusion

There are many barriers between SPMs and the thoughtful consideration and pursuit of technology insertion. It is reasonable to conclude that some SPMs do not thoroughly consider technology insertion because they want to avoid risks and/or they do not have the funds. And I suspect that some SPMs accept the expedient rather than the best solution especially if cost and/or schedule are going to be jeopardized. So how can we be sure that SPMs are selecting the "best" modifications for their systems? We will not know until audits or inspections can be done that include technology insertion as an item for evaluation and include both efficiency and effectiveness parameters.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Introduction

The purpose of this paper was to determine if Air Force Logistics Command (AFLC) is efficiently and effectively inserting technology into existing weapon systems through the modification process.

Conclusions

A review of Air Force regulations on modification management in chapter II revealed there is no Air Force policy to include technology insertion in the modification process. In November 1989, HQ AFLC added a requirement in their modification management regulation, AFLCR 57-21, to consider technology insertion in modification management. I concluded that the lack of top-down, integrated direction is one factor why technology insertion is not a significant consideration in modification management.

In chapter III, I described several AFLC programs to facilitate technology insertion. AFLC recently established a Chief Scientist, a senior management commitment to improving technology insertion in AFLC. The Weapon System Master Plans and the Technology Application Program Manager programs both expressed the command's desire to facilitate technology insertion. However, based on conversations with the Air Force Audit Agency and a HQ AFLC Inspector, I concluded that no one had performed an evaluation to determine if it was being done efficiently and effectively in the modification process.

Numerous barriers to technology transistion and insertion were described in chapter IV. The two impediments that I believe prevent many

AFLC System Program Managers (SPMs) from thoroughly considering technology insertion are risks and funds. I suggesting that some SPMs resist considering technology insertion because it represents technological and schedule risk and it often competes for limited modification funds which can be used to satisfy other requirements more cautiously and expeditiously. I concluded that we will not know if we are getting the "best" modifications until inspections can be performed that include technology insertion as an item for evaluation and include both efficiency and effectiveness parameters.

Recommendations

Air Force regulations should be revised to include technology insertion in the modification process. The Air Force Audit Agency and HQ AFLC Inspector General should be asked to include technology insertion in their evaluations of AFLC modification management. AFLC System Program Managers should be challenged to overcome the many barriers and make it a personal priority to ensure technology insertion is accomplished in the modifications to the weapon systems they manage.

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